

Digital Connection

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Networking (of a Social Kind), Printed Circuit Boards

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Originally in CQ Magazine, February 2010

On this day, the 40th anniversary of the Internet, as I write this column, tens or hundreds of thousands of people are looking for red balloons. The weather here in New Jersey is freezing rain, and I should be up the tower working on the antennas, but no: I have to suffer the indignity of sitting in front of a cozy fireplace, vicariously watching via the Internet a big lot of people seek out ten very special red balloons.

Our friendly DARPA (Defense Advanced Research Projects Agency), the central R&D organization for the US Dept. of Defense, has issued a challenge this day: Find ten 8-foot red weather balloons, tethered throughout the United States, and win \$40,000. They're supposed to be located where they'll be readily accessible and visible to thousands of people. But what's the point?

DARPA is running this "Network Challenge" to "explore the roles of the Internet and social networking play in the timely communication, wide-area team-building, and urgent mobilization required to solve broad-scope, time-critical problems." In other words, will Twitter or Facebook help lots of people work together?

This is a fascinating challenge, one with

problems to be solved that may not be readily apparent.

The first problem to be solved is finding enough people to cover the whole United States, looking for those balloons. There's clearly not enough money to split up the prize money amongst all the participants, but several groups have promised cash to those who are first to report a validated balloon sighting.

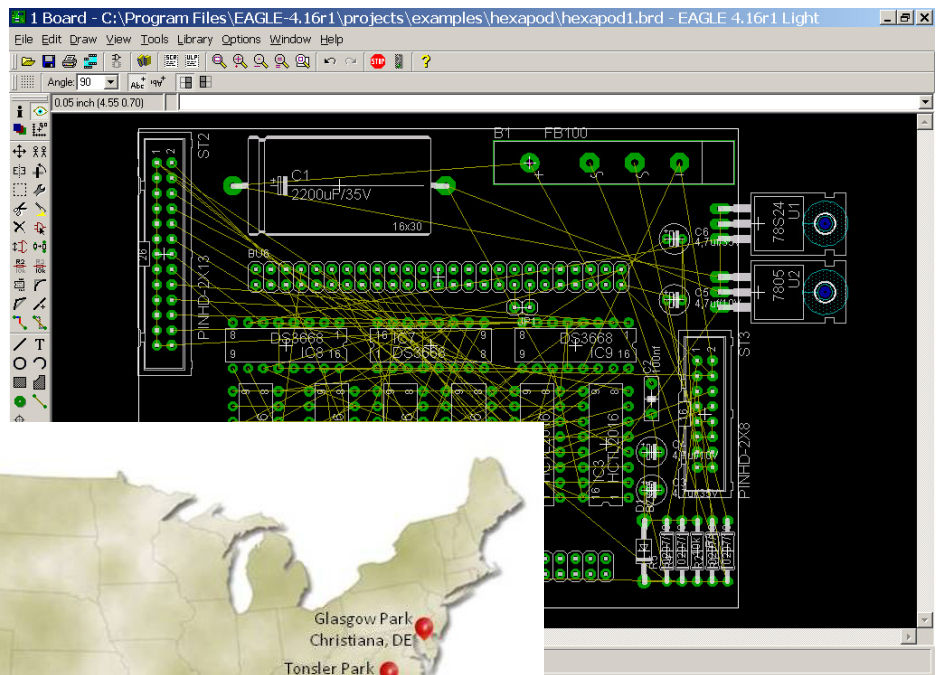
The problem goes deeper than simply finding a sufficiently large group. You need to be able to communicate with them in advance of the event, to make them aware of what they are supposed to be looking for, and then train and equip them to provide the correct information. A central point of contact needs to be established, one which everyone in the group can remember. And, there needs to be some system equipped to handle the potentially thousands of reports that may be received.

Ham Radio operators are a sufficiently large group. Communications shouldn't be a big problem – after all, what are we if not good communicators? – but there's a glitch: Part 97 says something about not having any pecuniary interest, and if there's prize money to be divvied up, it could become an issue. OK, so no communications using Amateur frequencies.



DARPA Network Challenge balloon number 10. This eight-foot red weather balloon (and nine more just like it) was displayed in a public place in the United States in an effort to see who could find all of them the fastest and win a \$40,000 prize. The winning team, from MIT, used the Internet and promised a cut of the prize money to entice participants. Photo courtesy of DARPA <<http://www.darpa.mil/>>

Communicating the details of all this takes time and resources. Almost every ham knows when the CQ WW contest is run, and the basics of how to “win”. But these dates and rules are established months or years in advance. This DARPA challenge (there have been several others in different subject areas)



After the MIT Red Balloon Challenge Team reported the location of all ten balloons in just under nine hours to win the challenge, this map of their locations was released. Despite dealing with misinformation (both unintentional and malicious) the team's plan for gathering and verifying reports was ultimately a winner. Image courtesy of DARPA <<http://www.darpa.mil/>>

An EAGLE Rat's Nest before the autorouter was started. The components were placed manually on the board and the electrical connections were created to

abilities in question? So, how do we filter out those reports that are simply incompetent, giving locations that are inadequate in some way? Or worse still, malicious reports that are purposely meant to deceive?

Then, there's the challenge or taking in all those reports, logging them and following

was announced at the end of October. Even if the Ham magazines – like CQ and QST - were to use the power of the press to bring this about, it would have been a few weeks past the editorial deadline for the December issue – and even that's cutting it a bit close.

Assuming one could find a good way to contact all (or almost all) the Hams in the USA, the problem of informing them what to do and how to report are relatively easy. Anyone with a license has proven they can read and follow instructions. The challenge rules called for a latitude and longitude report of each balloon's location, within 1 mile. Many of us have GPS or maps which can provide this – even Google Maps gives that information. But how to filter out the noise?

I mentioned that anyone with a license has the ability to follow instructions, but how many of us have encountered a “Lid”, a radio operator that - how shall I say it? – leaves those assumed

up somehow to verify each one. I can imagine that the receiving end of those reports will encounter conditions much like the pileups encountered by Dxpeditions, and checking for dupes (which in this case would be good) as any competitive contester would.

So, you may ask, what does this digital DARPA contest have to do with Amateur Radio?

Let's think about some of the more important things we do with the spectrum entrusted to us, for example Emergency Communications (EmComm). We need to perform a stated task (like “find people needing help”), often with little advance notice, accurately report locations, keep a list of information received, and again filter out any “noise” (unintentional or otherwise). Actually, we're pretty good at stuff like that, but once the dust settles on this challenge perhaps we can learn something from the participating teams.

Fast-forward to later in the day: Of more than 4000 registered to take part, the Red Balloon Challenge Team from MIT needed less than nine hours to correctly locate and report all ten balloons. They handed out most of the prize money to those who first reported each location (and smaller amounts to folks who referred those finders to MIT, and even smaller amounts to those who referred those referring folks, and so on), with the remainder going to charity. It seems that their recursive awarding of the prize money attracted a sufficient number of people to provide good data, and the 'open source' teams (who proposed awarding all the money to charity) did not fare nearly so well. Well, money IS often a good motivator...

It is still far too early to get any news about the methods tried and lessons learned, but a Google search reveals some interesting facts: Several teams show up as sponsored links from a search of "red balloon", each one offering some cash for good reports. On Twitter, there were several tweets that were intentionally deceitful, mostly worded like "red balloon spotted in Seattle" but without any details, or the exact same text coming from several different user names. Even DARPA reported there were "Multiple entries of spoof balloons submit-*ted*", since several people decided it would be a good day to fly an 8-foot red weather balloon in their neighborhood. And, "red balloon" was not one of the top 40 Google searches in the United States today.

By the time you get to read this, it should be easy enough to get the white papers on these efforts, so consider this a reminder to look those up and see if we can use any of their methods. Certainly we can learn some good lessons from the Challenge. What surprised me – I guess – was the large amount of "interference" from fake balloons, fake reports, and other "noise" sources. Disinformation, if not validated, can impact an entire operation – a good lesson to know. With some effort, perhaps we can organize and win the next DARPA challenge?

Printed Circuit Boards

To fill in the rest of this month's column, a few comments about Printed Circuit Boards, or PC Boards. I hope you're familiar with PC Boards, considering that point-to-point wiring essentially disappeared in the early 1970s. Just in case, a PC Board is a piece of fiberglass or other material, maybe a millimeter thick, with a thin layer of copper laid out

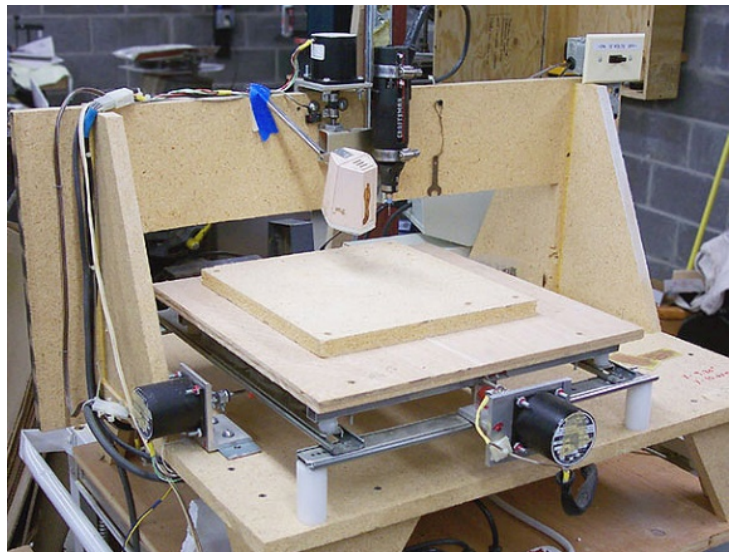
in a pattern to interconnect several electronic components.

When building a very simple circuit, I might opt for point-to-point or maybe dead-bug wiring (Google those terms if they're unfamiliar) but more often than not I'll make a PC Board. They are very easy to make, provide good support for components, and really help when making more than one or two of something.

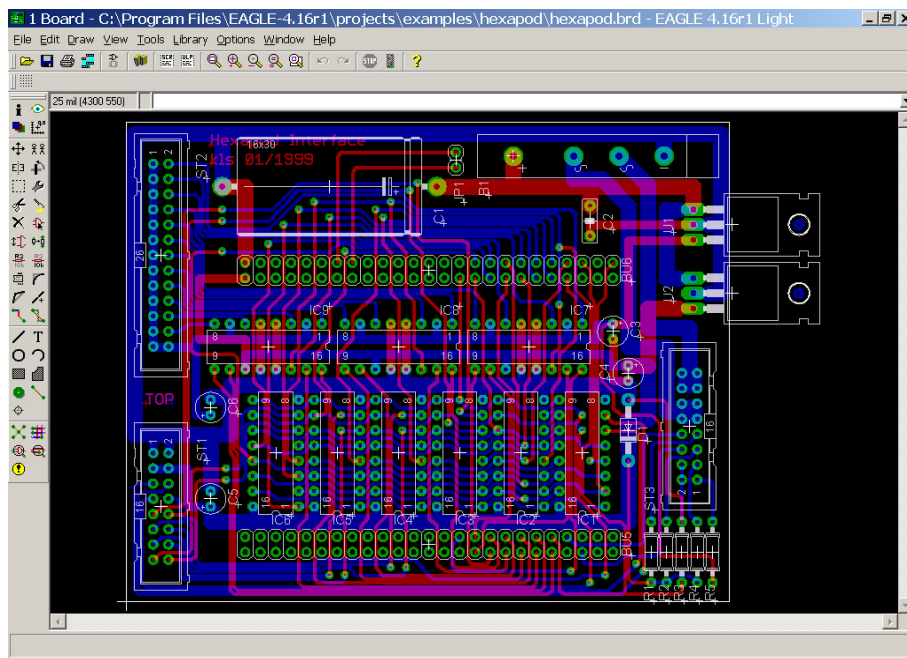
The process works like this: You buy some raw PC Board material, which has a thin layer of copper on one or both sides, cover the parts of the copper you want to keep, and chemically etch away the uncovered copper. Drill some holes for through-mount components, solder it all up, and you're done. You can cover the copper with etch-resist tape (kind of like masking tape, but narrower), rub-on transfers, or even certain inks (like from a Sharpie® marker), but all of these methods take the same effort for each board, a problem when you're making more than one.

For a few boards, you can employ a photographic process using specially-treated PC Board material and ultraviolet light, and for production quantities a silkscreen method is economical.

All of these methods depend on some kind of plan for the layout of the copper lines. Small and simple circuits can be laid out by hand, but for larger and more complex circuits we use software.



My PC Board Drilling machine, built from plans I saw in a magazine. It is controlled through the parallel printer port of an ancient IBM PS/2 Model 30 computer running at 4.77 MHz booting off the floppy drive. The DOS 6 operating system, CAD/CAM control program and several drill data files all fit on a 720 kB 3.5" floppy with plenty of room to spare. More proof that old computers still have value.



The same board after autorouting for a two-layer PC Board and some manual tweaking, especially for the wide ground and power paths, as well as moving a few components around for a better fit. This is one of the sample boards that comes with EAGLE.

My first PC Board designs were made in PC Paintbrush, an application that came with Windows 3.0 (and still is found on the All Programs/Accessories menu) on a scale of 300 pixels to the inch. Later I bought Easy-PC for DOS from Number One Systems in the UK; I think I paid about \$100. This was a huge leap forward at the time, since professional software was still in the thousand-dollar or more range.

EAGLE Layout Editor from CADsoft <<http://www.cadsoftusa.com>> is what I use today. There are several versions available, from a 'light' version with size and layer limitations, all the way up to the full-blown professional version for about \$1500. Unless you're in the business, you won't need to spend nearly that much.

My old Easy-PC software was little more than a highly specialized drafting system. I could draw a PC Board layout, or a schematic, but it was all completely manual – locating the components and drawing all the circuit connections. EAGLE has Schematic Capture and an Autorouter, which really automate and simplify the whole process.

Schematic Capture is a fancy way of saying that it can read the circuit schematic and, if you tell it a little about the components you plan to use, will produce a PC Board that has all the connections in the right places. The result is called a "Rat's Nest", since the connecting lines are just drawn straight, directly from point to

point, and need to be reworked so they don't cross over each other. But moving them is easier and less prone to error than making the connections manually.

An autorouter takes that concept one step further, taking all those connections in the Rats Nest and redrawing them so they don't cross over each other, producing a complete and ready-to-etch PC Board pattern. In some cases the autorouter can't make a few connections so you'll have to manually route a few traces using a jumper wire, and in other cases the result is a little less than optimal, so you might want to nudge some of the lines around. But overall, the

process takes a fraction of the time – minutes instead of hours – and accurately follows the schematic to avoid errors.

Rather than give you a tutorial on setting up and using EAGLE, I just want to introduce you to the software and urge you to download and try it out. The autorouter is fascinating to watch in action, and the results are pretty darn good.

Maybe some time in the future I'll write about the CNC PC Board drilling machine I built. Let me know if you're interested.

Until next time,
vy 73 de N2IRZ.